REMARKS

Claims 1-14 and 17 are pending in the case.

Claims 1-4, 6, 10, and 12 -14 and 17 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Hansen et al. US 5,589,256, the '256 reference.

Claims 1, 5-11 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Hansen et al (US 5,589,256) as applied to Claims 1- 4, 12 -14 and 17 and further in view of Hansen et al. US 5,789,326, the '326 reference.

Amendments to the Claims

Claim 1 has been amended to indicate that the crosslinking agent is an α-hydroxy polycarboxylic acid. Claim 2 has been canceled and incorporated into Claim 1. Support for citric acid, an α-hydroxy polycarboxylic acid, is found on page 13, line 1 and Tables 1 and 3, page 13 and 16, respectively. Malic acid, also an α-hydroxy polycarboxylic acid is cited in Table 2, page 15. The curing temperature range has been amended to 185 °C to 215 °C, support is found on page 9 where the curing range is given as 120 °C to 215 °C and more specifically on page 15 where fibers are cured at 182°C. Additionally, the Whiteness Index, ($WI_{(CDM-L)}$) of the individualized crosslinked cellulosic fibers is now recited as greater than about 73. Support is found in Table 3, page 16.

The Rejection of Claims 1-4, 6, 10, 12-14 and 17

Claim 1 has been amended to recite curing occurs at a temperature from 185°C to 215°C and as such does not overlap the range cited by Hansen. Support is found on page 9 where the curing range is given as 120 °C to 215 °C and more specifically on page 15 where fibers are cured at 182°C. Additionally, the Whiteness Index, ($WI_{(CDM-L)}$) of the individualized crosslinked cellulosic fibers is now recited as greater than about 73. Support is found in Table 3, page 16. Claim 2 has been canceled and incorporated into Claim 1 to recite that the crosslinking agent is an α-hydroxy polycarboxylic acid.

The Supreme Court in KSR reiterated the framework for the objective analysis for determining obviousness under 35 U.S.C. 103 stated in *Graham v. John Deere*

Co., 383 U.S. 1,148 USPQ 459 (1966). Obviousness is a question of law based on underlying factual inquiries. The factual inquiries enunciated by the Supreme Court in KSR are: (a) determining the scope and content of the prior art, (2) ascertaining the differences between the claimed invention and the prior art; and (3) resolving the level of ordinary skill in the pertinent art.

Applicant's agent submits the Examiner has not established a *prima facie* case of obviousness. Applicant's agent submits that, as amended, the invention is nonobvious.

Hansen teaches the binding of particles to fibers. The binder has a functional group that forms a hydrogen bond with the fibers and a functional group that is also capable of forming a hydrogen bond or a coordinate covalent bond with particles that have a hydrogen bonding or coordinate bond with particles that have a hydrogen bonding or coordinate covalent bonding functionality. The fibers have hydrogen bonding functional sites. The fibers can be wood pulp fibers and includes those that are pretreated prior to the application of the binder. The binders can be polymeric or non polymeric as cited in column 3, line 42 –column 4, line 18 and column 19 line 50 – column 20, line 61.

Application of the binder on high bulk fibers preferably occurs after the curing step, particularly if the binder is capable of functioning as a crosslinking material. Hansen cites that specific types of *binders that can crosslink are polyols,* polycarboxylic acids and polyamines. When these are present during curing the binder will be consumed to form covalently crosslinked bonds. When this occurs the binder is no longer available for hydrogen bonding or coordinate covalent bonding and particle binding to fibers is ineffective, column 23, lines 4 - 15. Hansen discloses that when polycarboxylic acid, polyols, and polyamines are used as binders, the fibers should contain at least 20 % by weight water if particles and binders are present in the fibers when curing. The water inhibits covalent bond formation and prevents all of the binder from being used to form intrafiber covalent crosslinks. Thus some of the binder remains available to form non-covalent bonds with the particles, column, 23, line 7 – line 32.

Even though Hansen discloses specific types of binders that can crosslink such as polyols, polycarboxylic acids and polyamines, when crosslinking occurs, the

binders are consumed and would destroy his invention. Hence there is the necessity of adding at least 20 % by weight water to inhibit covalent bond formation thus preventing all the binder being used to form covalent bonds. As a consequence, some binder remains to bind the particles. Thus one skilled in the art would not look to a reference that teaches binding of particles to fibers to increase of the Whiteness Index of the crosslinked fibers since crosslinking in the presence of a binder such as a polyol that can also crosslink destroys the binding that Hansen teaches.

Furthermore, there is no teaching or suggestion in the Hansen et al. '256 reference to arrive at the instant invention and all elements of the claim are not cited. Hansen et al. teach away from using curing temperatures greater than 180°C. Also, the results of crosslinking of an α-hydroxy polycarboxylic acid in the presence of a polyol and measuring the Whiteness Index after curing at from 185°C to 215°C gives unexpected synergistic Whiteness Index results and the product is different from the product of the Hansen invention.

The results are unpredictable since one skilled in the art would not have predicted that when cellulose fibers were crosslinked with an α-hydroxy polycarboxylic acid in the presence of a polyol such as sorbitol would result in a Whiteness Index greater than 73 when curing was conducted at 185°C to 215°C. One skilled in the art would envision increasing the Whiteness index of discolored fibers by bleaching with a reactive chemical such as hydrogen peroxide or alkaline hydrogen peroxide but not with a polyol such as sorbitol.

The '256 patent indicates that high bulk fibers with intrafiber crosslinks (i.e. covalent bonds) can be used in the invention, column 37, line 22-25. The reference teaches however, that in the preparation of these fibers, the curing stage temperatures of 140 °C to about 180 °C are used which is sufficient to effect curing of the crosslinking agent *without scorching* the dry fibers, column 40 line 63 - 66. The reference teaches that the dried and cured fibers *are not discolored* from *scorching* and the like, column 41, line 7-10. Thus the reference also teaches away from curing at higher curing temperatures which would result in scorched and discolored fibers. One skilled in the art would recognize that discolored fibers would have a different structure that those claimed in the instant application which have a high Whiteness Index as indicated in Claim 1 and where

the fibers are cured at 185°C - 215°C. The scorched fibers would have a different structure than those in the instant application which have a high Whiteness Index as indicated in Claim 1.

A factual inquiry in determining obviousness is resolving the level of ordinary skill in the pertinent art as defined in MPEP2141 II C., the person of ordinary skill in the art is a hypothetical person who is presumed to have known the relative art at the time of the invention. Factors that may be considered in determining the level of ordinary skill in the art may include: (1) "type of problems encountered in the art," (2) "prior art solutions to those problems;" (3 "rapidity with which innovations are made;" (4) "sophistication of the technology; and (5) "educational level of active workers in the field. In a given case, every factor may not be present, and one or more factors may predominate." "A person of ordinary skill in the art is also a person of ordinary creativity, not an automation" KSR 82 USPQ2d at 1397."

Certainly Hansen is a person skilled in the art and fits the above definitions yet the disclosure of Hansen indicates that the curing temperature should be within the range of about 140°C to 180°C which is sufficient to effect the curing of the crosslinking agent without scorching the dry fibers. Hansen states the curing temperature depends upon the type of crosslinking materials used to treat the fibers and also is set at a level so as not to scorch the fibers during curing. Also, Hansen states that the fibers are not discolored from scorching, column 40, line 62 – column 41, line 9. Thus the only mention that Hansen makes is the adverse effect on color when crosslinked fibers are cured above 180°C. Hansen, being skilled in the art, does not disclose or recognize the beneficial effect of crosslinking cellulose fibers with an α-hydroxy polycarboxylic acid in the presence of a polyol to achieve to claimed Whiteness Index. Furthermore, since Hansen discloses crosslinking at from about 140°C to 180°C and recognizes that higher temperatures result in scorching and discoloration, being skilled in the art, would also recognize that the product from discoloration would have a low Whiteness Index relative to the claims in the instant application and therefore would also have a different structure than those in the instant application. Yet, in the instant application, curing from 185°C to 215°C results in a Whiteness Index of greater than about 73 and therefore the structure is unobvious since it is different from the Hansen disclosure.

Applicants submit that curing the crosslinking agent in the presence of a polyol gives unexpected synergistic Whiteness Index results. The Examiner is requested to again review the Declaration of Angel Stoyanov submitted on October 9, 2006. Pulp has a Whiteness Index of 78.16 (Sample A). When pulp is treated with a catalyst, the Whiteness Index is 73.87 (Sample B). When pulp is treated with a catalyst and sorbitol, the Whiteness Index is 73.37 (Sample H). When pulp is treated with citric acid and a catalyst, the Whiteness Index *decreases to 68.69* (Sample C). However, when pulp is treated with citric acid and a catalyst in the presence of sorbitol, the Whiteness Index *increases to 78.71* (Sample D). Thus whereas citric acid has an adverse effect on the Whiteness Index decreasing it from 78.16 (Sample A) to 68.69 (Sample C), when citric acid crosslinking of the fiber occurs in the presence of sorbitol, the Whiteness Index increases to 78.71 (Sample D) indicating an unexpected synergistic response by the addition of the sorbitol. The Whiteness Index measurements resulting from crosslinking cellulose with an α-hydroxy polycarboxylic acid in the presence of sorbitol, a polyol, at 182°C (360 °F) and 193°C (380 °F) are shown in Table 3 of the instant application show this unexpected synergistic effect.

Similar results are also realized when crosslinking cellulose fibers with citric acid in the presence of xylitol.

The '256 reference states that binders and particles of the invention can be added before, after or simultaneously with curing, column 42, line 31 – line 32. Hansen states that specific binders that can crosslink are *polyols*, polycarboxylic acids and polyamines and when such binders are present during curing the binder will be consumed during the curing step to form covalently crosslinked bonds. In the instant application, as now amended, cellulose fibers are reacted with an effective amount of an α- hydroxyl polycarboxylic acid crosslinking agent in the presence of a $C_4 - C_{12}$ polyol to form intrafiber crosslinked cellulosic fibers with a Whiteness Index (WI_{CDM-L}) greater than about 73. If polyols cited by Hansen in the '256 reference indeed do crosslink then the structure of the final product would be different from the product in the instant application since, for example, sorbitol and xylitol are shown not to crosslink, see the August 21, 2006 Declaration of Stoyanov, entries H, I, J and K as evidenced by no increase in FAQ wet bulk. Hansen states that when curing the crosslinking material in

the presence of a binder that is also a crosslinking material the fibers should contain at least 20 % water by weight of the fibers when curing begins, column 42, line 31 – line 57. Water inhibits ester bond formation and ensures that adequate binder will remain in the fibers to bind particles to the fibers. The Declaration of Stoyanov, dated March 17, 2008 and attached herewith, shows that water does not inhibit the crosslinking reaction of citric acid which is both a binder, column 16, line 59 and a crosslinking agent, column 42, line 40. Thus the results are unexpected and nonobvious. Furthermore, the results are not predictable.

Applicants submit there is no motivation or suggestion in the Hansen et al. invention to arrive at the instant invention since, in the curing stage, Hansen et al. recite curing temperatures from 140 °C to about 180 °C and indicate that this range prevents scorching and discoloration and therefore a person skilled in the art would not be motivated to cure at higher temperatures because of the adverse effect on fiber color. Hansen et al. do not disclose all elements of the claims such as the Whiteness Index of greater than about 73. Hansen et al. teach away from using curing temperatures greater than 180°C stating that these higher temperatures scorch and discolor the fibers. Furthermore the results of crosslinking cellulose with an α-hydroxypolycarboxylic acid in the presence of a polyol give unexpected synergistic results in the Whiteness Index and the results are unpredictable.One skilled in the art would not expect that a polycarboxylic acid such as citric acid, an α-hydroxypolycarboxylic acid, which when crosslinked with cellulose has an adverse effect on the color of crosslinked cellulosic fibers yet when crosslinked with cellulose in the presence of a polyol would increase the Whiteness Index ($WI_{(CDM-L)}$) of the crosslinked fibers. This is unexpected since both sorbitol and cellulose are polyols and one skilled in the art would not think that a monomeric polyol would prevent the adverse effect on fiber color when citric acid is crosslinked with cellulose which is a polymer, in the presence of a polyol, leave alone increase the Whiteness Index. Since Claim 1 is nonobvious under U.S.C. § 103 (a) then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir.1988). Withdrawal of the rejection is respectfully requested.

Withdrawal of the rejection is respectfully requested.

The Rejection Of Claims 1 and 5-11 Under U.S.C. 103 (a)

Claims 1, 5-11 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Hansen et al (US 5,589,256) as applied to Claims 1- 4, 12 -14 and 17 and further in view of Hansen et al. US 5,789,326, the '326 reference.

If an independent claim is nonobvious under U.S.C.103 then any claim dependent therefrom is nonobvious. *In re Fine,* 837 F.2d 1071, 5USPQ2d 1596 (Fed. Cir.1988).

Claim 1 is an independent claim. Claims 5-11 are dependent on Claim 1.

The Hansen '256 reference has been discussed above. Like the '256 reference, the '326 reference teaches binding of particles to fibers with binders. The binder molecule has at least one functional group that is capable of forming a hydrogen bond or at least one coordinate covalent bond with particles and at least one functional group that is capable of forming a hydrogen bond with the fibers, column 4, line 8 – line 12.

Like the '256 reference, Hansen states that in the production of high bulk fibers, polycarboxylic acids such as citric acid can be used for crosslinking, column 43, line 8 and are cured in a temperature range of from 140°C to 180°C without scorching the fibers and are not discolored from scorching, column 45, line 6 – line 18. Thus Hansen, who is skilled in the art, recognizes the adverse effect of temperatures greater than 180°C which would result in scorching and discoloration of the fibers. Furthermore, as now amended, the disclosed curing temperature does not significantly overlap the claimed range.

Hansen states that in certain situations the binder can also form covalent intrafiber crosslinks. Polycarboxylic acid such as citric acid, *polyols,* such as dipropylene glycol and polyamines can function as crosslinking agents and are consumed in the curing step in the formation of covalent crosslinks, column 46, line 7 – line 12. Hansen discloses that about 20 % water but more preferably 30 % water by weight of the fibers will sufficiently retard curing so that adequate binder functional groups remain in the fibers to bind the particles to the fibers. Hence when curing the crosslinking material in the presence of a binder that is also a crosslinking material

the fibers should contain at least about 20 % by weight water when curing begins, column 46, line 8 – line 26.

Applicant's agent submits there is no motivation to combine the references and use malic acid, which like citric acid is an α-hydroxy polycarboxylic acid, in combination with another binder to achieve the instant invention.

Hansen states that binders have functional groups that may be selected without limitation, independently or in combination from the group consisting of carboxyl, carboxylate, a carbonyl, a hydroxyl, a sulfonic acid, a sulfonate, a phosphoric acid, a phosphate, an amide, an amino and combinations thereof, column 25, line 61 –line 63. *Hansen states that combination of the binders as well as with other binders also may be used providing they are non reactive, that is, providing that the binders do not react in a manner which prevents the binder from possessing the functional groups required for binding, column 27, line 3 – 8.* Citric acid is a binder, column 25, see structural drawing. Citric acid is also a crosslinking agent, column 46, line 9 and is therefore reactive. The same logic applies to malic acid which, as mentioned, is an α-hydroxyl polycarboxylic acid. As mentioned earlier, Hansen states that polyols, such as dipropylene glycol and polyamines can function as crosslinking agents and thus be consumed in the crosslinking reaction. Thus Hansen teaches away from using an α-hydroxy polycarboxylic acid such as citric acid and malic acid and a polyol as a binder because of their reactivity. The Examiner cites the '326 Hansen patent for sorbitol, column 51, line 45, and that the other polyols cited in the instant claims embrace sorbitol. As cited in the '326 patent, sorbitol is used as a binder in wet laid fibers. Furthermore Hansen does not disclose alicyclic or heterosides as polyols or the specific polyols they embrace. Since Hansen also states that polyols can function as crosslinking agents and thus be consumed in the crosslinking reaction then Hansen teaches away from using citric acid or malic acid and a polyol as a binder because of their reactivity.

According to Hansen one would have to add at least 20 % by weight water when curing the crosslinking material in the presence of binder that is also a crosslinking material. As shown by the Stoyanov Declaration submitted herewith, adding 20 or 30 % by weight water to fibers which have been treated with a

crosslinking agent (citric acid, an α-hydroxy polycarboxylic acid), a polyol (sorbitol), and a catalyst and then air dried, followed by the addition of water and then cured, does not affect crosslinking as shown by no change in the wet bulk (Samples B3 and B4, respectively, vs control samples A3 and B3 which have no post drying water addition). This effect is both non predictable and unexpected. According to Hansen, however, the addition of the water would prevent crosslinking. Furthermore, as shown in the Declaration by Stoyanov of August 21, 2006, fibers crosslinked with citric acid, an α-hydroxy polycarboxylic acid and 2 % by weight sorbitol, an acyclic polyol, results in a Whiteness Index of 81 versus a control in which no polyol is present of 68.69. This result is unexpected.

Hansen does not disclose the Whiteness Index greater than about 73, the reference does not show all the structural limitations of the claims when cellulose fibers are crossslinked with an α-hydroxy polycarboxylic acid. The fibers in the instant application are crosslinked at 185°C to 215°C, a temperature which Hansen states would scorch and discolor the fibers of his invention and thus the Hansen fibers would have a different structure due to discoloration at this elevated temperature. The fibers of the instant application have a different structure from that of Hansen, have a high Whiteness Index relative to those of Hansen, the results are unexpected and a synergistic response is realized. While both the '256 and the '356 patents teach curing of high bulk fibers at 140°C to 180°C, both teach away from curing at the higher temperatures in the instant application. Hansen states that binders may be used in his invention providing they are non reactive. As has been stated, citric acid is a reactive binder, Hansen states that polyols can function as crosslinking agents and therefore are reactive. Hansen must add water which prevents crosslinking to obtain the binding of particles. Furthermore, it has been shown that in the case of the instant application addition of water to the prior to the curing stage does not hinder the crosslinking reaction and a different structure must therefore be present. Withdrawal of the rejection is respectfully requested.

CONCLUSION

Based on the foregoing, Applicant's agent submits that the application is in condition for allowance and request that it proceed accordingly. If the Examiner has any further questions or comments, the Examiner is invited to contact the Applicant's agent.

Respectfully Submitted

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